



# Transport Infrastructure LCA

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Presentation at workshop of the International Transport Forum:  
Life Cycle Assessment Methods to Support India's Efforts to Decarbonise Transport  
13 April 2021



# Main Research Question



*Infrastructure is the skeletal structure of civil society.*

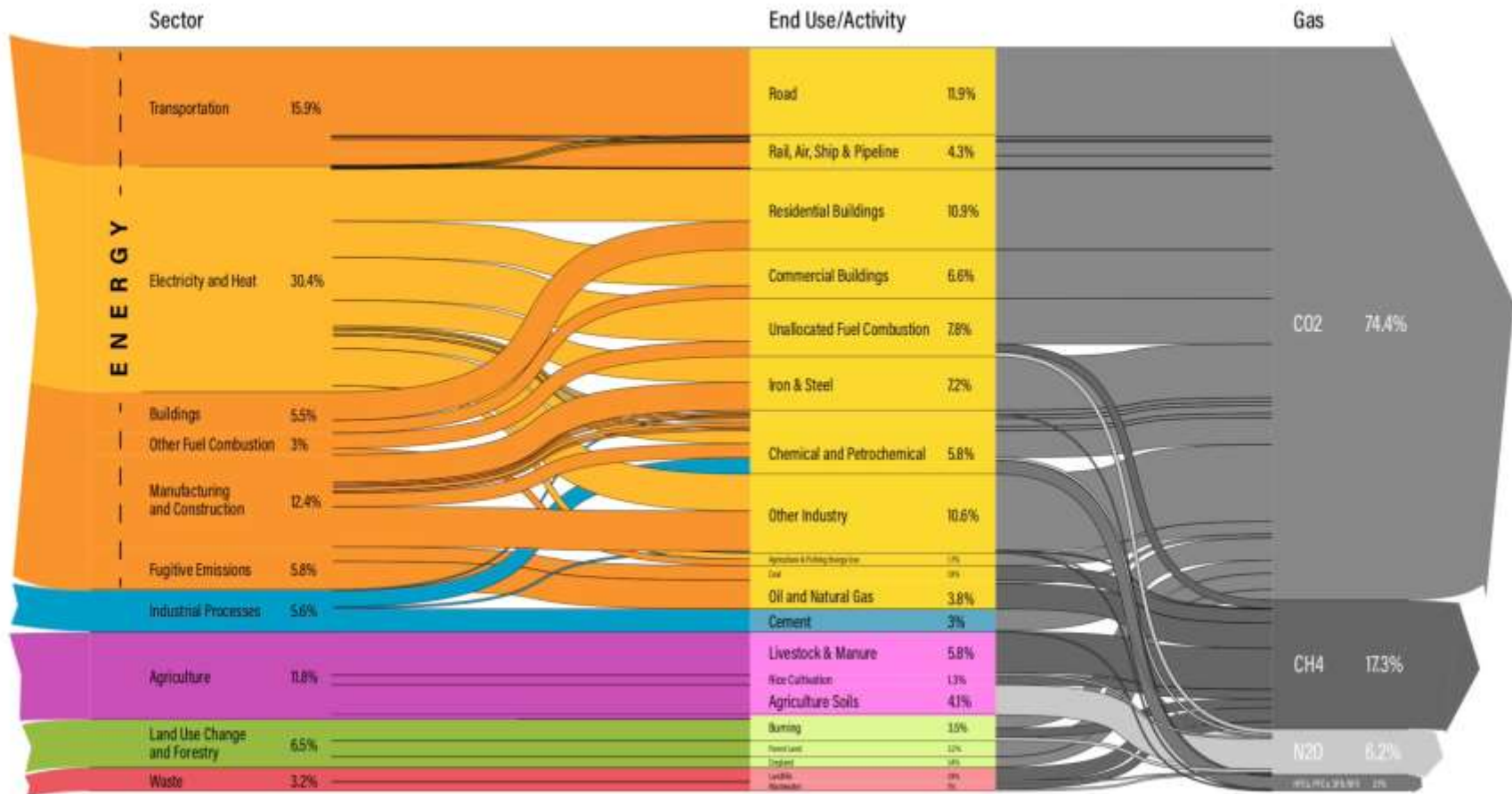
*What is the relationship between infrastructure provision and the society we create? Where are the levers for improvement?*



# Transport is a large driver of GHG emissions

## World Greenhouse Gas Emissions in 2016

Total: 49.4 GtCO<sub>2</sub>e



Source: Greenhouse gas emissions on Climate Watch. Available at: <https://www.climatewatchdata.org>

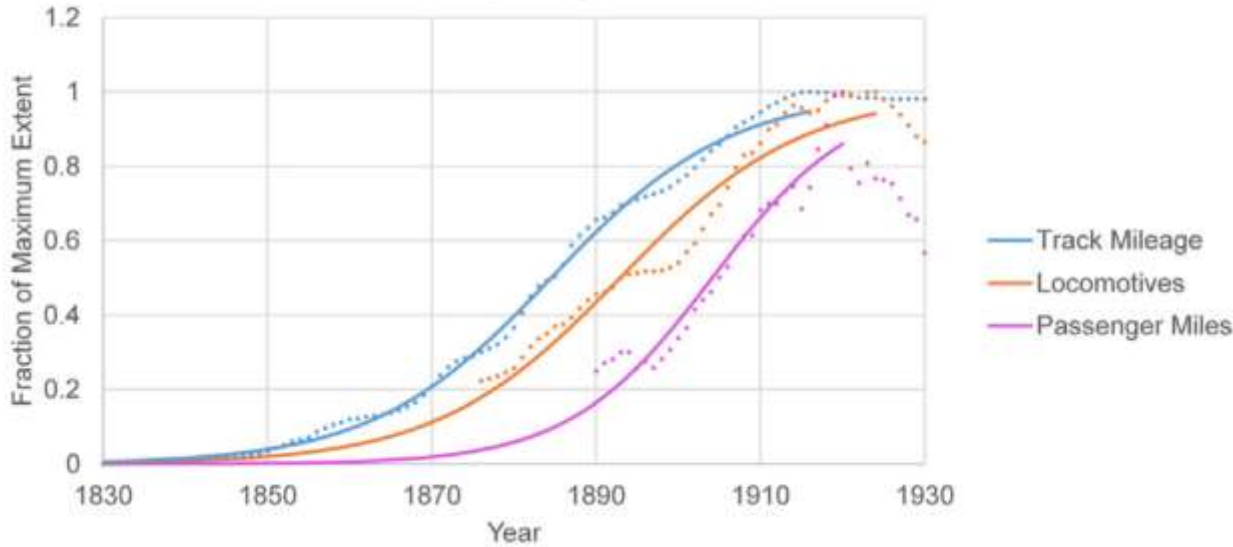


# Life Cycle Assessment

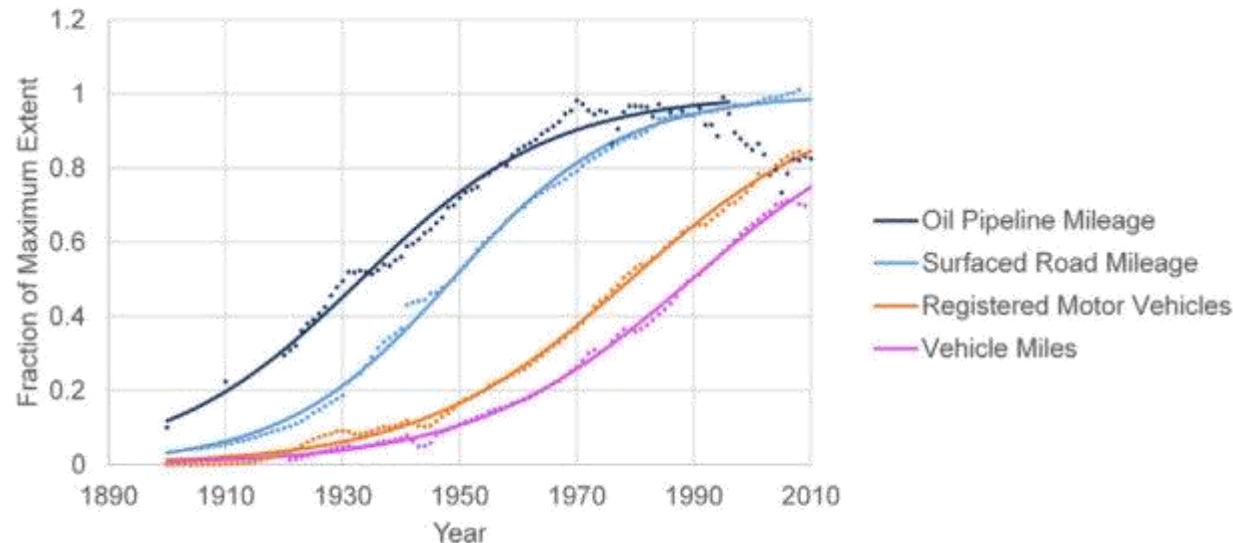
“A process to evaluate the environmental burdens associated with product, processes or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and materials used and released to the environment; and to identify and evaluate opportunities to affect environmental improvements. The assessment include the entire lifecycle of the product, process or activity, encompassing extracting and processing raw materials; manufacturing, transportation and distribution; use, reuse, maintenance; recycling and final disposal”

# Infrastructure comes first

Railroad Transport System in the United States



Motor Vehicle Transport System in the United States



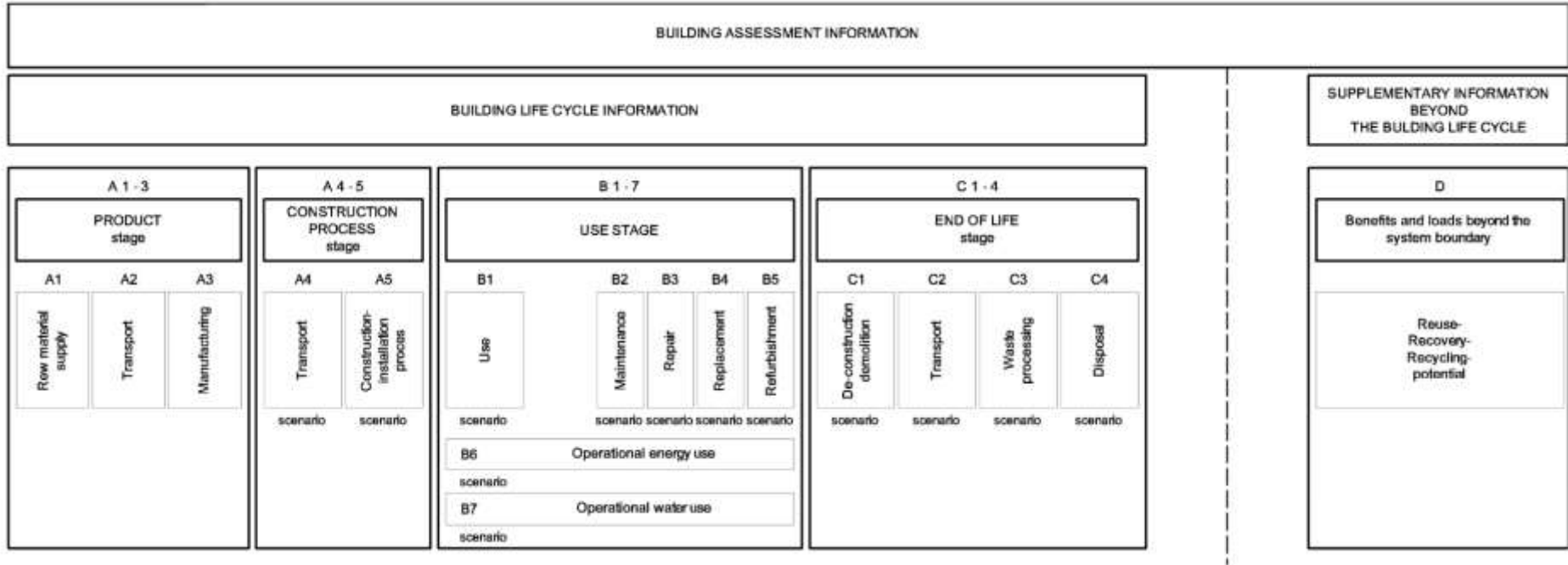


What to build?

How to build?



# Construction LCA

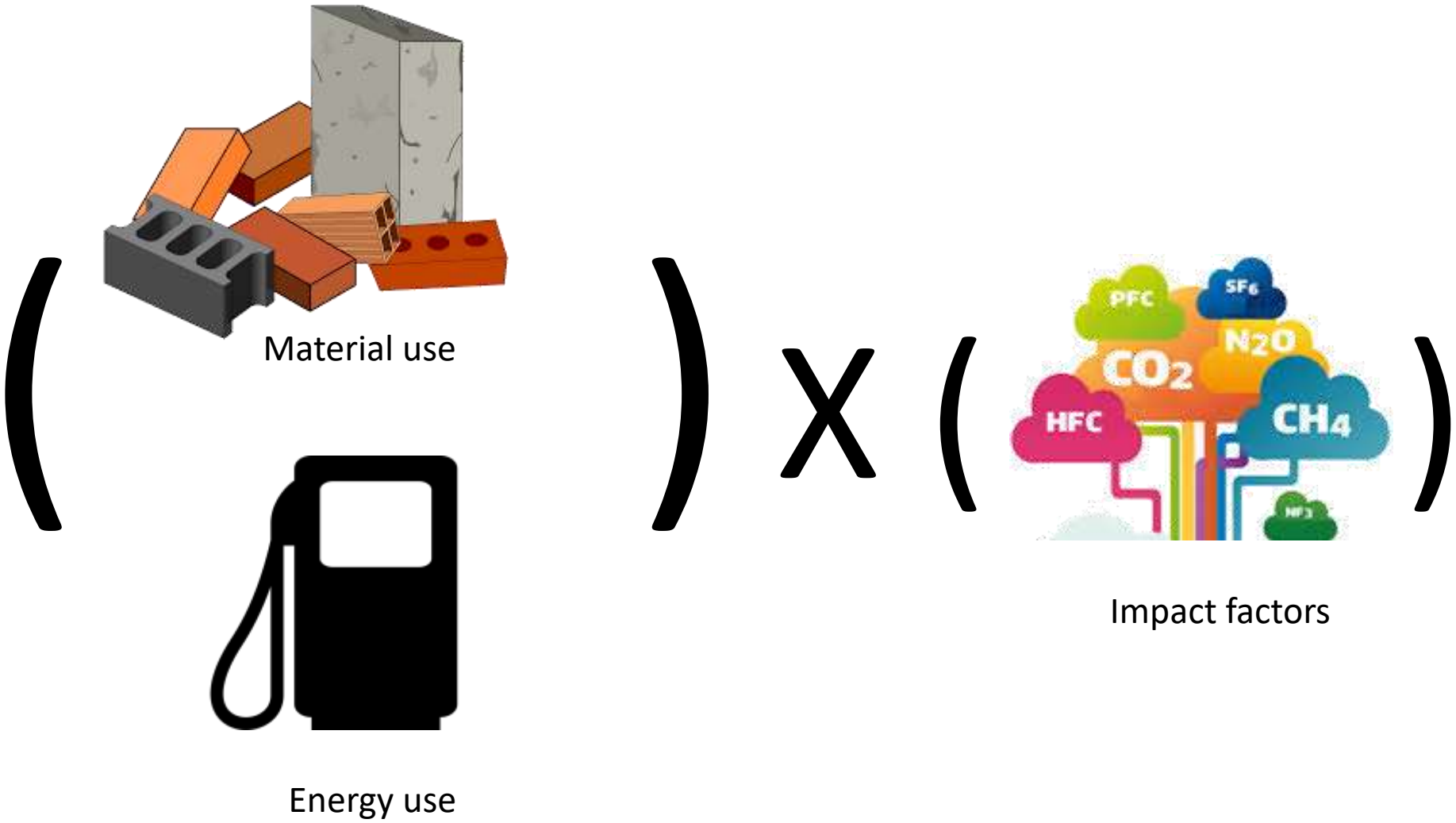




LCA and transportation infrastructure...



# Construction impacts





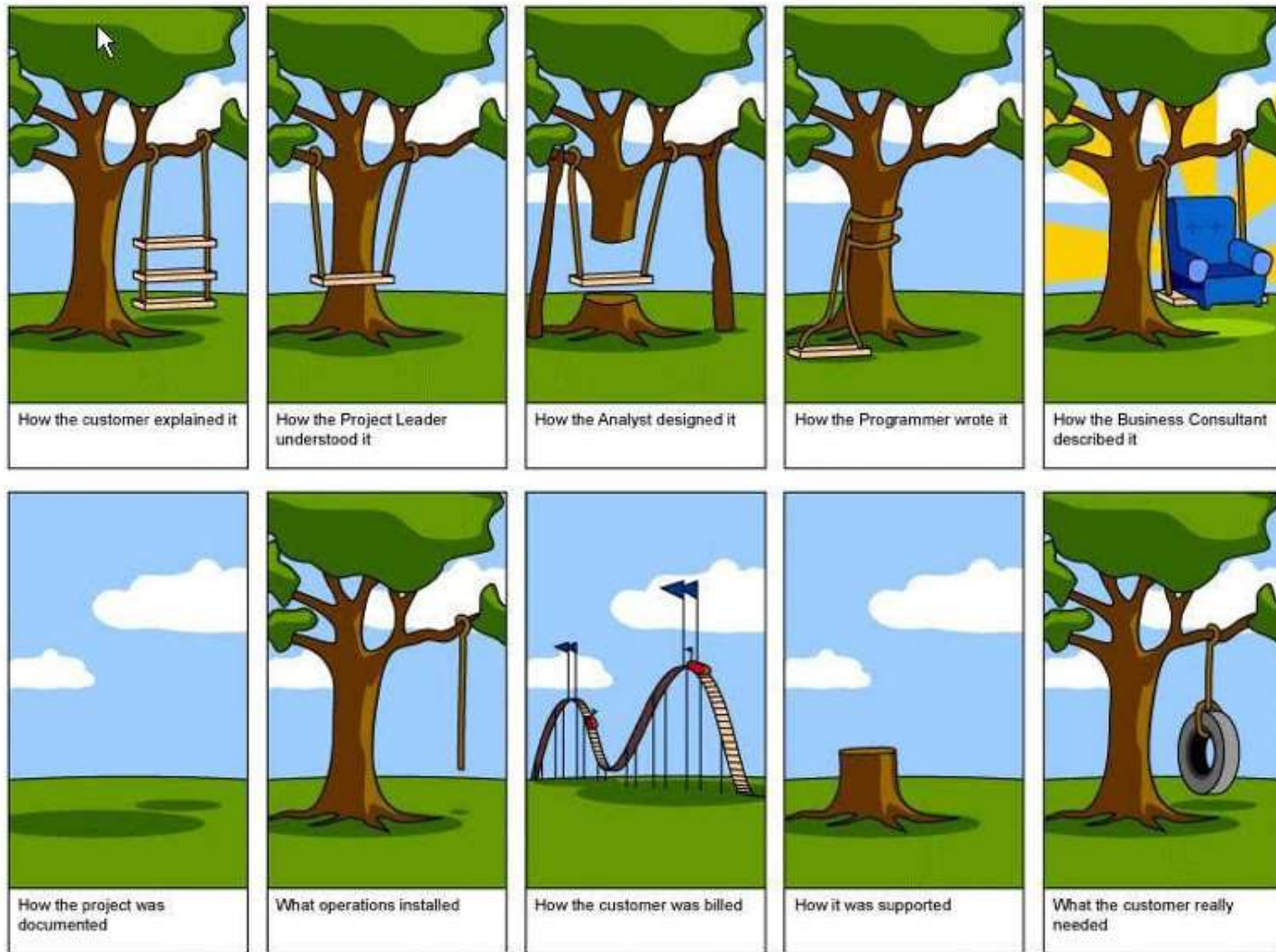
# Construction



Noland RB and Hanson CS (2015) Life-cycle greenhouse gas emissions associated with a highway reconstruction: A New Jersey case study. *Journal of Cleaner Production* 107. Elsevier Ltd: 731–740. DOI: 10.1016/j.jclepro.2015.05.064.

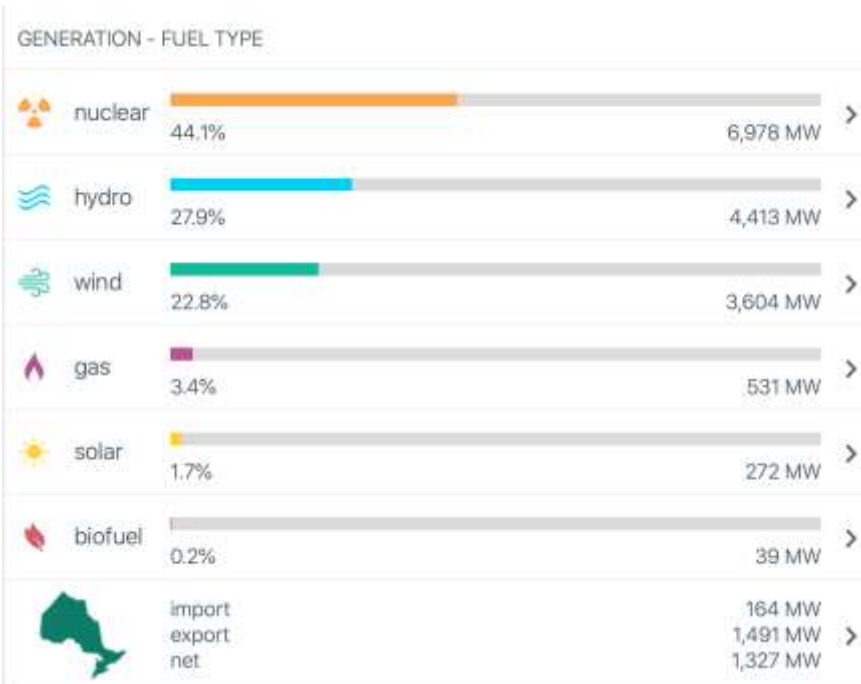


# Division of responsibilities/Data





# Energy needs for mobility

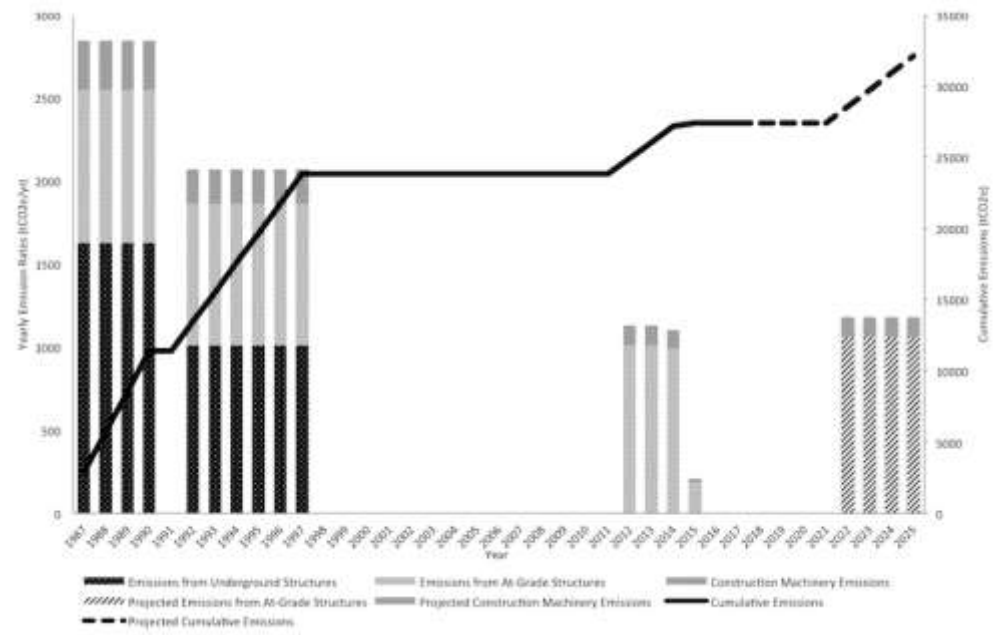


CO<sub>2</sub>e INTENSITY

17 g/kWh

LOW AVG HIGH

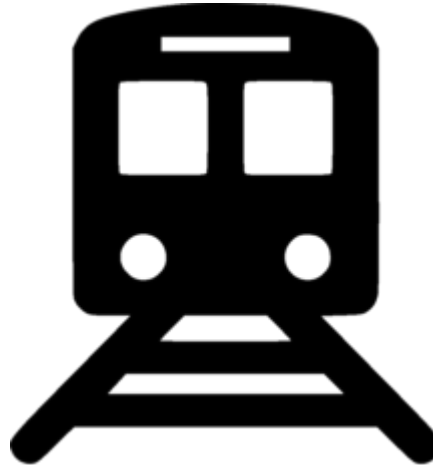
# Maintenance/Refurbishment



Makarchuk, B. and Saxe, S. (2019) 'Embodied greenhouse gas emissions of the Spadina streetcar - A temporal approach including maintenance', *Journal of Infrastructure Systems*, <https://ascelibrary.org/doi/full/10.1061/%28ASCE%29IS.1943-555X.0000475>



# Mode choice



Buehler, R. (2011) 'Determinants of transport mode choice: a comparison of Germany and the USA', *Journal of Transport Geography*. Elsevier Ltd, 19(4), pp. 644–657. doi: 10.1016/j.jtrangeo.2010.07.005.

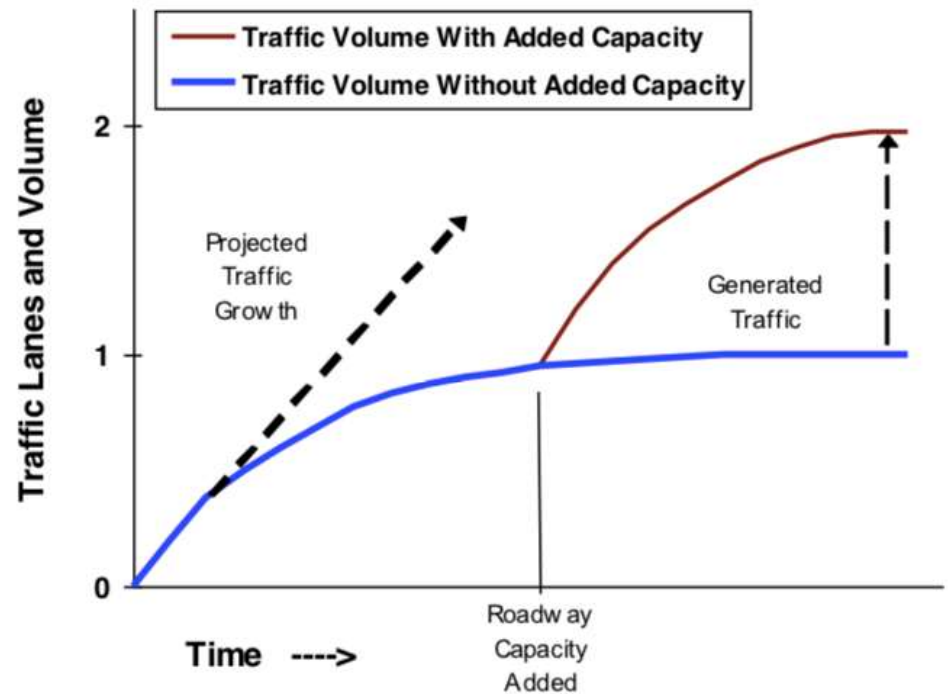
Buehler, R. *et al.* (2017) 'Reducing car dependence in the heart of Europe: lessons from Germany, Austria, and Switzerland', *Transport Reviews*. Taylor & Francis, 37(1), pp. 4–28. doi: 10.1080/01441647.2016.1177799.



## Demand response

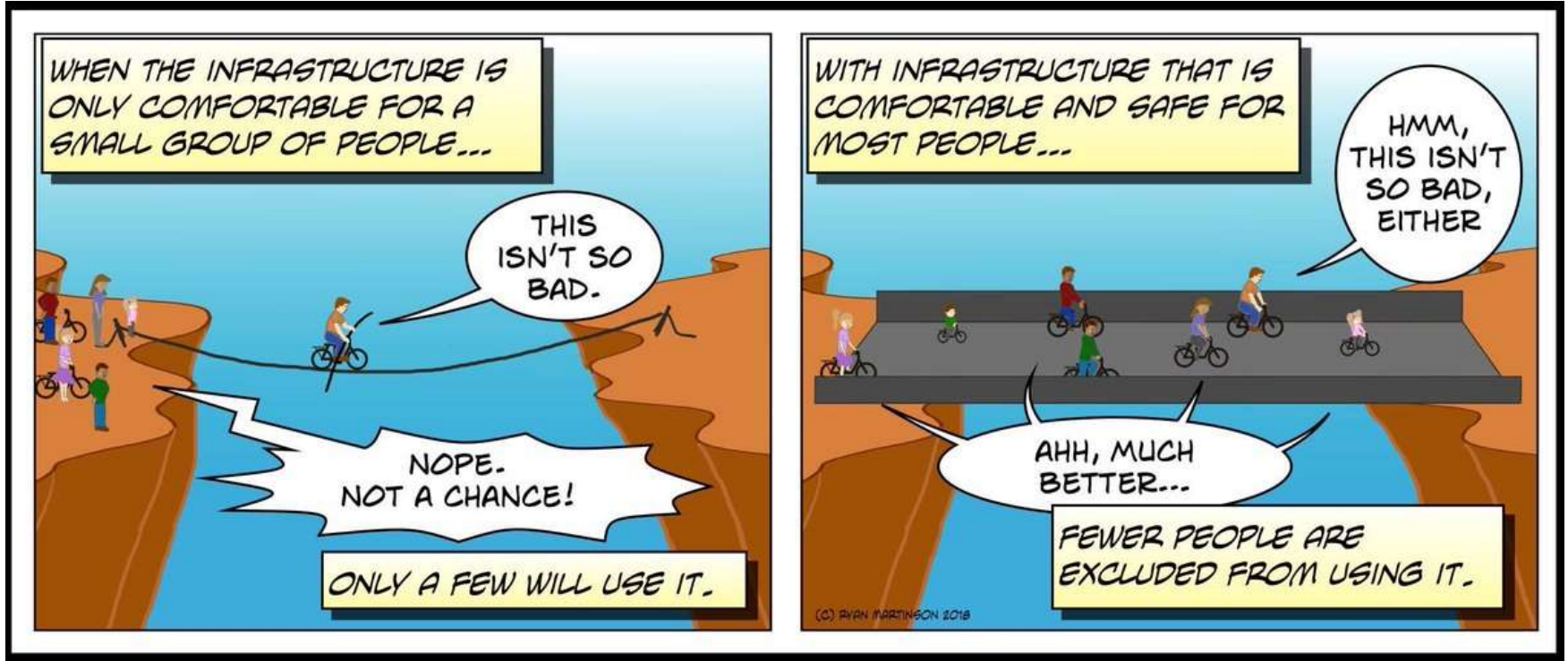
“any policy that reduces congestion without otherwise making driving more expensive ... will tend to attract new traffic that at least partially offsets the policy’s effect on congestion”

-Hymel et al 2010



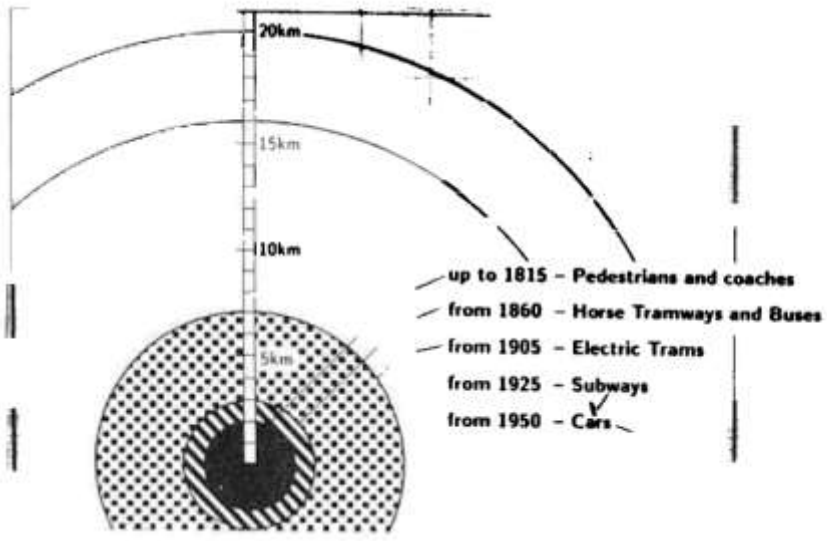


# Induced Demand

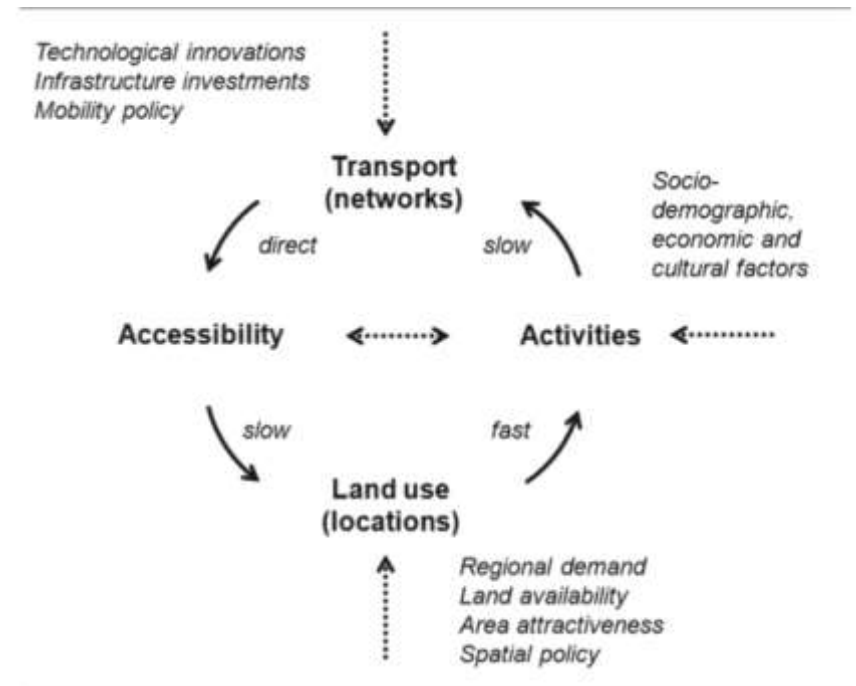




# Transport - Land Use



City size with dominant travel mode

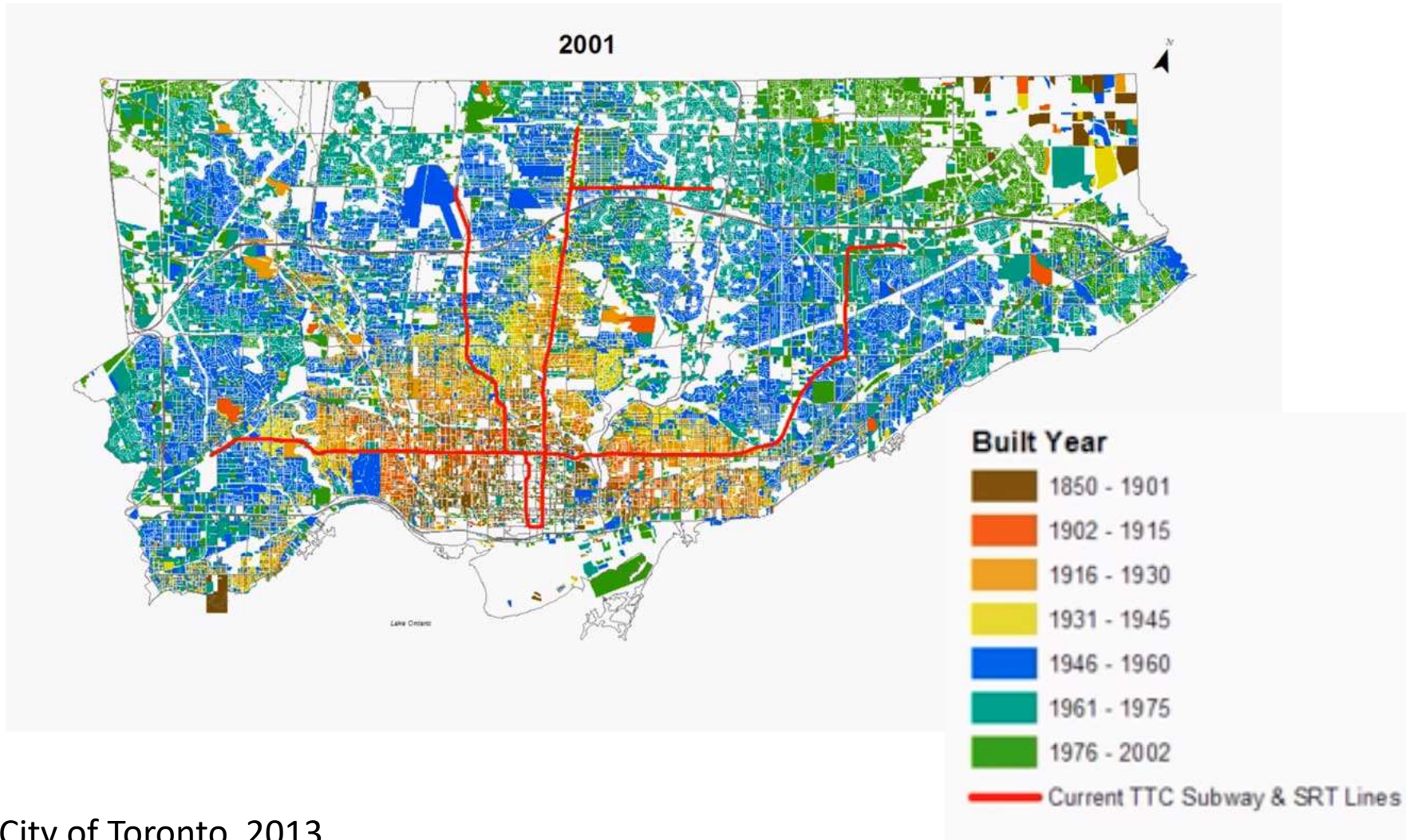


Feedback loop between transport and land use

Bertolini, L. (2012) 'Integrating mobility and urban development agendas: A manifesto', *disP*, 48(1), pp. 16–26. doi: 10.1080/02513625.2012.702956.

Marchetti, C. (1994) 'Athropological Invariants in Travel Behaviour', *Technological Forecasting and Social Change*, 47, pp. 75–88.

# Land use, land use change, and forestry (LULUCF)





# Transport Infrastructure and Land use: Long term impacts

Article

## The impact of urban proximity, transport accessibility and policy on urban growth: A longitudinal analysis over five decades

**Dena Kasraian**

Delft University of Technology, The Netherlands; University of Toronto, Canada

**Kees Maat and Bert van Wee**

Delft University of Technology, The Netherlands

Urban Analytics and  
City Science

Environment and Planning B: Urban  
Analytics and City Science  
0(0) 1–18



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## Roman Roads to Prosperity: Persistence and Non-Persistence of Public Goods Provision\*

CARL-JOHAN DALGAARD

NICOLAI KAARSEN

OLA OLSSON

PABLO SELAYA

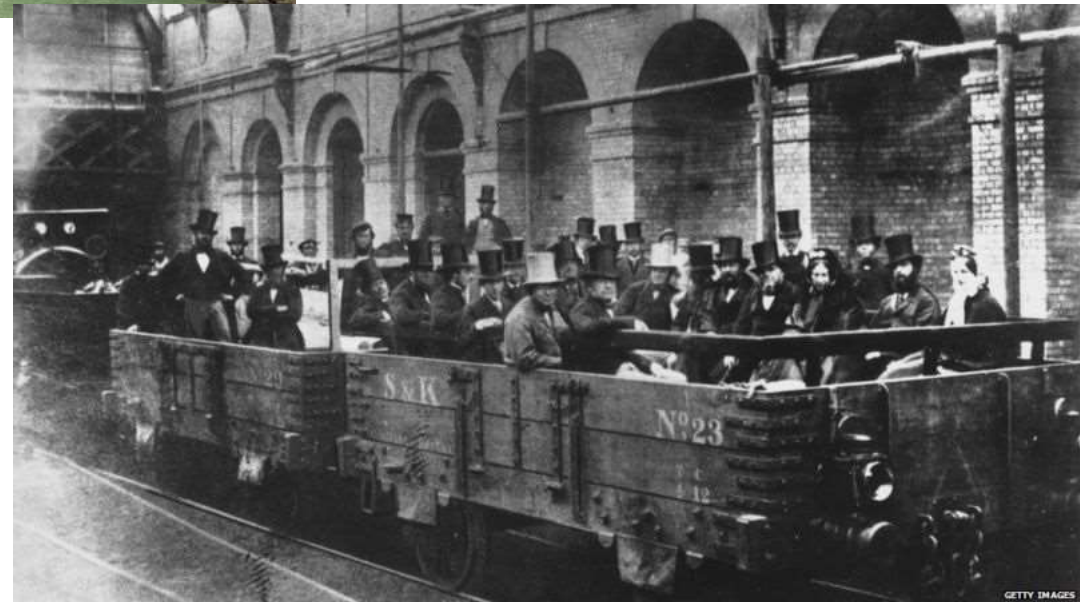
July 9, 2018



End of life?



Pons Fabricius, Rome, 62 BCE



London Underground, 1863

<https://www.bbc.co.uk/newsround/20953143>

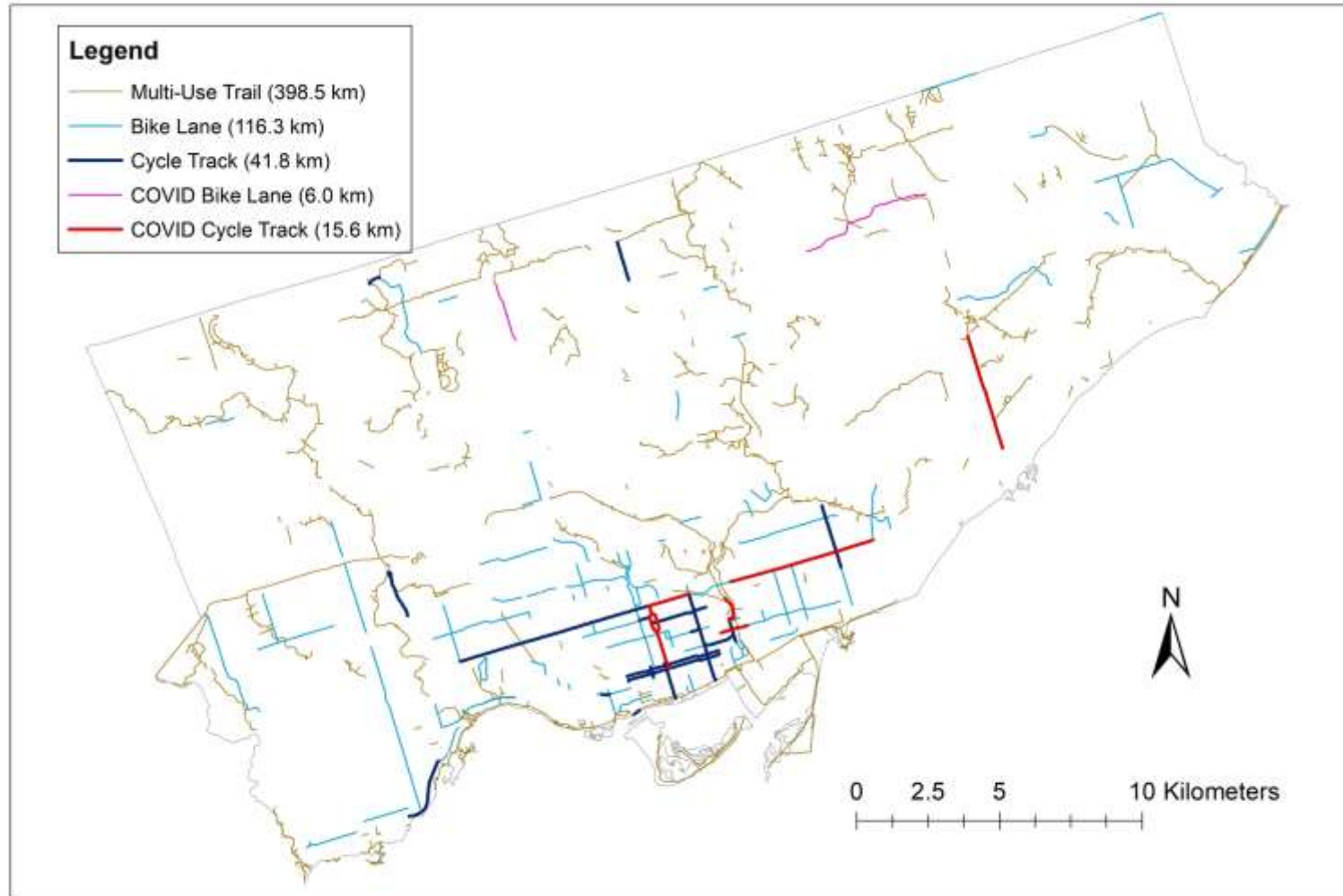
<https://www.shutterstock.com/video/clip-11850530-bridge-pons-fabricius-over-tiber-river-rome>

# Persistent and hysteretic



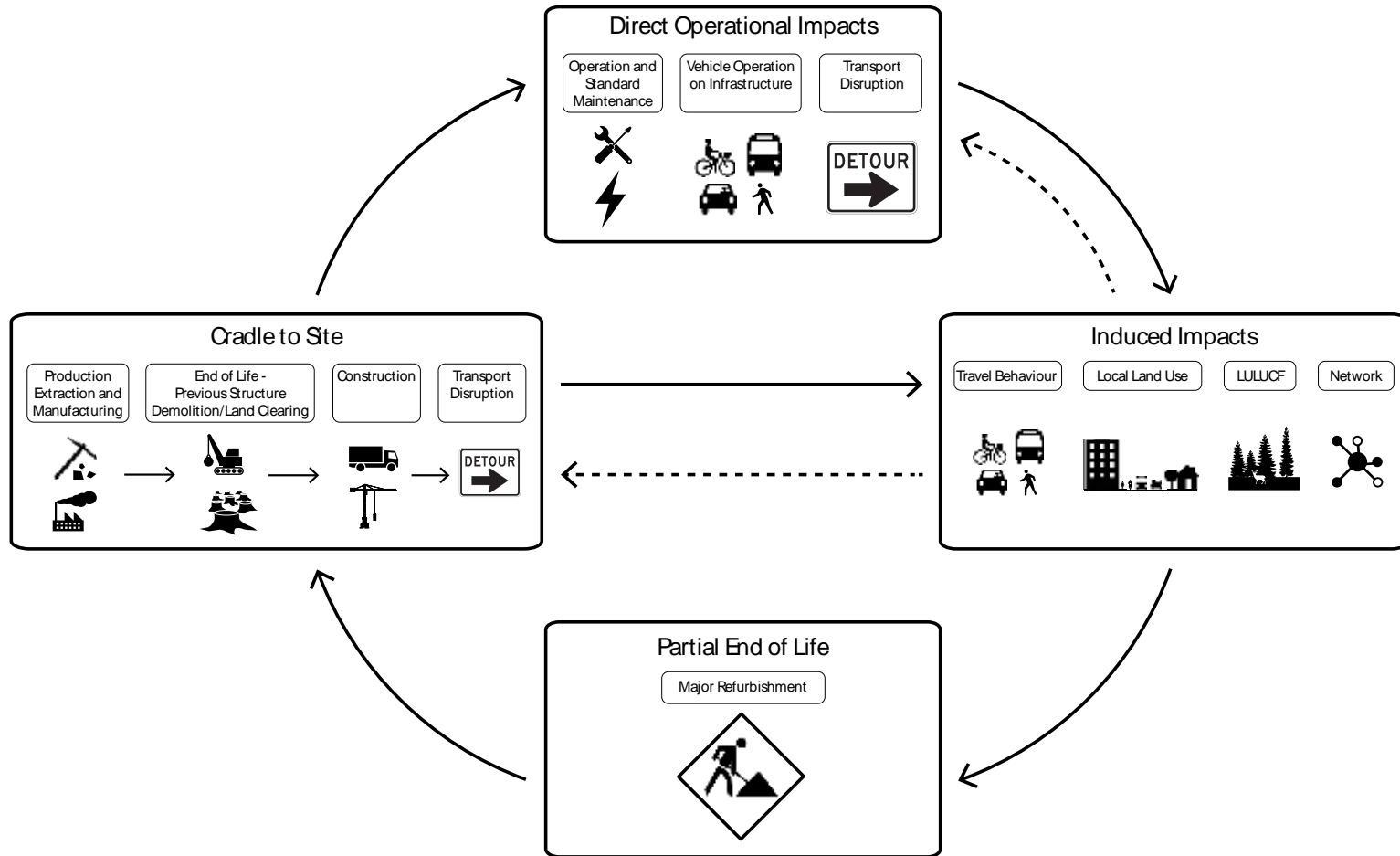
Burchfield, M., Overman, H. G., Puga, D., & Turner, M. A. (2006). Causes of sprawl: A portrait from Space. *The Quarterly Journal of Economics*, 121(2), 587–633. <https://doi.org/10.1162/qjec.2006.121.2.587>

# Network Effects





# Holistic considerations...





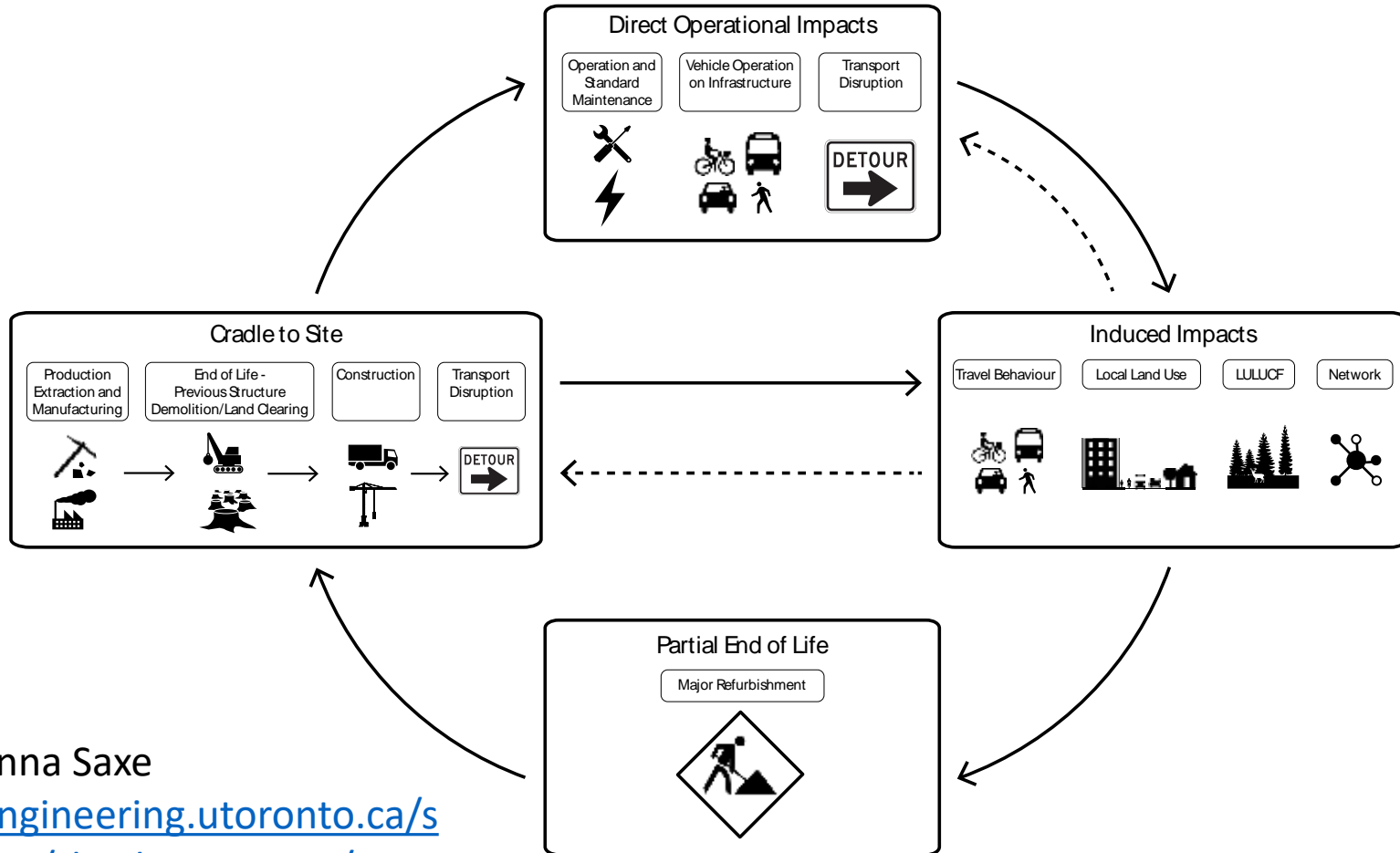
## So what?

- Transport infrastructure's boundaries are wide and long
- Infrastructure comes first
- Huge knock on (indirect) impacts
- Infrastructure choice nearly impossible to undo (need to stop digging)





# Thank you!



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